8-15-1997

DUAL INFORMATION SYSTEMS FOR WORK AND WORK REDESIGN

Timo Kakola
University of Turku, kakola@utu.fi

DUAL INFORMATION SYSTEMS FOR WORK AND WORK REDESIGN

Timo Käkölä
Turku Centre for Computer Science and
University of Turku
Department of Computer Science and Information Systems
FIN-20520 Turku, Finland. E-mail: kakola@utu.fi

Introduction and Research Questions

1. INTRODUCTION AND PROBLEM SETTING

Organizations need powerful technological support to create and share knowledge to introduce new work practices, products and services. But powerful technological support is constrained because many organizations suffer from *dualistic*, institutionalized information systems (IS) that hide their constructed nature from users.

Dualistic IS suffer from the design/use dualism: because the design of IS is temporally, spatially, and conceptually separated from the use of IS, the conceptual design of Dualistic IS hides the intricate relationships between the computerized and noncomputerized aspects of work practices. Dualistic IS embed part of organizational rules and resources in software and databases in such a way that users cannot fully understand and thus question (when necessary) the meaningfulness of these resources and rules. Dualistic IS are mainly *media* rather than conscious *outcomes* of usersí intentions and work practices, and thus may endanger the process of social reinvention that complex technological artifacts should undergo when put to use. Käkölä (1996) analyses reasons for and implications of dualistic technologies in detail.

Integrated IS are extreme instances of Dualistic IS. They hide their constructed nature to the extent that they may appear to agents as knowledgeable subjects rather than media and outcomes of work (Nurminen, 1988).

Dual Information Systems (DIS) (Käkölä, 1996) help individuals and teams (1) see their work, including its computer-supported parts, holistically and from multiple perspectives; (2) learn new skills that allow them to bring to the surface and critique the deep, self-reinforcing structural and behavioural patterns; (3) share different, possibly ambiguous interpretations; (4) manage the resulting chaos productively to yield innovative working and learning practices; (5) evaluate and experiment with these practices; (6) constructively negotiate control of the rules and resources deployed; (7) disseminate the best practices; and (8) enact them efficiently.

What is the conceptual design of DIS that reinforces both effective, institutionalized working and the (re)construction of computer-supported work routines? What kind of social processes and structures facilitate the creation of DIS? This paper draws on Käkölä (1996) to provide potential answers to these questions.

Prerequisites for and Implications of DIS

DIS transcend the design/use dualism by conceptually uniting computerized and noncomputerized aspects of work, and thus foster effective working and work redesign. The conceptual design of DIS is a conceptualization of an IS architecture in which the design/use dualism is collapsed *vertically*, between the developers and users of IS, and *horizontally*, between agents and business units whose work processes are interconnected by IS. Except for work redesign, important nonroutine activities such as product and market development fall outside the scope of DIS.

At least two parallel change processes are necessary to realize DIS. First, a new conceptual design of an organizational IS architecture must be devised that unites people and their work with computerized aspects of work. Second, this design must be aligned with an organizational design that supports the use of knowledge at work and the creation of knowledge to reconstruct work. These designs help organizations produce productive interaction or ìfitî with DIS. The fit is productive when these interactions facilitate the efficient enactment and effective reconstruction of work routines.

I use Nurminenís (1988) act-oriented perspective as a basis for the conceptual design of DIS. The perspective helps bridge the design/use dualism (a) vertically by seeing the knowledge encoded in software by designers in time-space context A as the acts of users in time-space context B and (b) horizontally by making explicit the coordinating role of IS when the acts are inter-connected through shared objects of work in integrated databases.

I use Nonakaís (1994) ìhypertext organizationî design to complete the theoretical foundation of DIS. A hypertext organization is formed by the combination of hierarchically organized business units and self-organizing project teams that pursue the visions of top management by drawing on and accruing to the organizational knowledge base. Hypertext organizations are comprised of knowledge-base, business, and project layers. The knowledge-base layer ìembraces tacit knowledge, associated with organizational culture and procedures, as well as explicit knowledge in the form of documents, . . . computerized databases, etc.î (Nonaka, 1994, p. 33). Work routines are enacted by a formal organization in the business layer. The project layer provides a field of interaction where project teams create knowledge.

I elaborate the hypertext organization design into the ìhyperknowledge organizationî design that enables and is enabled by the conceptual design of DIS. Hyperknowledge organizations have a set of business units on the business layer. The IS architecture of each unit follows the conceptual design of DIS, and each has significant autonomy over how it conducts business and uses IS. Business units compete internally and are rewarded for their performance, process innovations, and the adoption and development of these innovations by other units. Project teams share knowledge within and between business units to redesign work processes.

I divide each business unit in the business layer into a set of functional work groups. Each group is responsible for a clearly defined part of the work process(es) of a business unit. While the business layer is always organized as a bureaucracy, the groups relax some of the characteristics of bureaucracies. In a hyperknowledge organization, agents cannot be mere executors of pre-defined tasks. The gap between the business and project layers would be too wide if agents in the business layer had no discretion over their work and suddenly had to make decisions in the project layer about their business unit as a whole. Therefore, the groups have broad authority to manage their own work routines. Middle management, together with project teams, set the overall direction and periodically redesign work processes of the business unit.

The Conceptual Design of DIS

The conceptual design of DIS has three primary layers: (1) agents draw on *the business layer of DIS* to learn, enact, and coordinate activities; (2) project teams use *the project layer of DIS* to produce innovative work and IS (re)designs that can be enacted on the business layer; (3) *the knowledge sharing server (KSS) of DIS* is a repository of knowledge in the knowledge-base layer. In addition, *the breakdown layer of DIS* helps agents zoom in on the details of work and handle breakdowns.

The business and breakdown layers of DIS

The business layer of DIS provides many services to help ensure that agents in the functional groups of the business layer can: (1) easily enact routines according to partly prescribed work flow procedures, (2) develop and maintain a theoretical, systemic understanding of their work, and (3) monitor their work performance using quantitative and qualitative performance metrics.

Käkölä (1995a) presented an approach to instantiate the business and breakdown layers of DIS into Embedded Application Systems (Eriksson and Nurminen, 1991), that is, computer applications that follow the act-oriented structure. They enable the effective enactment of computer-supported routines. Process models serve as the interface through which the computerized tasks and knowledge become inseparable components of agentsí working and learning environment.

When routines break down, agents can use the services of the breakdown layer of DIS to deepen their theoretical knowledge of computer-supported work, find out what is wrong, recover (possibly by modifying manual and/or computerized parts of routines), and quickly return to their routines. If recovery is not possible because breakdowns are too severe and/or span multiple functional work groups, agents can enter and effectively contribute to the project teams that redesign work.

The project layer of Dual Information Systems

The project layer of DIS helps project teams in all phases of work process design from the conceptualization of problems and goals to networking the design knowledge into the business layer through training seminars, the services of the business layer of DIS, and the Knowledge Sharing Server. The project layer of DIS provides five services for reflecting and redesigning work: (1) Argumentative dialogue; (2) Benchmarking; (3) Modeling; (4) Simulation; and (5) Authoring services.

The conceptualization of work-related dilemmas and objectives is supported through argumentative dialogue services. These services promote free and candid expression of ideas as well as constructive criticism validated by reasoned arguments; both are key conditions for the effective creation and sharing of knowledge.

Benchmarking services support the refinement of ideas into a thorough understanding of oneís own work process(es), its weaknesses and strengths, and possible design solutions. These services enable business units to share competitive work arrangements, and thus foster constructive competition between business units and help units bridge the design/use dualism horizontally.

Process modeling services support the crystallization of design solutions into a testable work and IS redesign. Hyperknowledge organizations depend critically on effective modeling of computer-supported work practices. On the business layer of DIS, organizational and software process models help agents understand and perform their routines. On the project layer of DIS, the models are used to analyze and benchmark work processes, to crystallize the knowledge created into work processes that unite computerized and noncomputerized aspects of work, to simulate and negotiate the processes, and to make them available for the business layer and redesign projects.

Simulation allows testing of the proposed redesign. It is effective to estimate and refine the performance of the redesigned computer-supported work processes. Work and IS designs that are unlikely to meet performance goals can be eliminated before implementation.

Argumentative dialogue services also support constructive negotiation over the rules and resources specified in the redesign as well as the monitoring of the negotiation process itself. These services are essential because the redistribution of responsibilities may trigger embarrassment and threat. If organizations cover up these social processes or use IS to bypass them, the formation of defenses will likely accelerate and the creation of knowledge deteriorate (Käkölä, 1995b).

Authoring services support the design of learning services that nurture the internalization and enactment of the redesign in the business layer of DIS. They are complementary to modeling services. They rely on multimedia technologies that have more bandwidth than process models to capture and represent knowledge embedded in the physical actions of agents.

In summary, the combined dialogue, simulation, and authoring services help organizations ensure that much of the deterioration of the flexibility of IS use can be eliminated during design. Modeling services support the act-oriented perspective and help unite the IS designs conceptually with people and their work designs.

The knowledge sharing server (KSS) of DIS

KSS is a repository of knowledge in the knowledge-base layer of a hyperknowledge organization. KSS is conceptually outside the boundaries of business units. Collaboration with other businesses through KSS is beneficial because knowledge sharing increases internal diversity. KSS holds both current and historical process knowledge. The primary levels of analysis in KSS are the work process(es) of each business unit and each functional group. Individuals and their performance should not be of interest to redesign project teams. Therefore, KSS need not include information on individuals.

KSS should be seen as an index of organizational knowledge with links to the sources of information in the business units. Agents using the different layers of DIS can follow these links, and thus internalize redundant information, enlarge their own knowledge, and create new concepts to improve their computer-supported work.

Conclusions and Future Research

Dual Information Systems in hyperknowledge organizations transcend the design/use dualism. First, the business layer of DIS, through its act-oriented structure, enables agents to see their computer-supported work as a whole. Second, the services of the DIS architecture together with the other structural properties of a hyperknowledge organization help individuals even in the lower organizational echelons (a) use the business layer of DIS to develop shared stocks of knowledge of work routines, (b) interact in project teams to crystallize their knowledge into work redesigns, and (c) store this knowledge in KSS so that it can be used by other people to reflect on and reconstruct work.

There are many opportunities for future research. The conceptual design of DIS should be validated and refined. Constructive research is a viable approach. Prototypes following the conceptual design of DIS can be built and tested in a laboratory environment to find out to what extent agents can use the knowledge provided by the business layer and the knowledge sharing server of DIS to redesign their work with the project layer of DIS.

Other research approaches are also needed. The hyperknowledge organization design is an ideal model. It helps organizations compare work practices, structures, and technologies with the corresponding properties of the model, and thus improve their designs of computer-supported work. Empirical research is needed to validate and refine the conceptual design of DIS and to investigate (1) to what extent organizations should align their IS architectures and organizational designs with those envisioned in this paper, and (2) how this alignment can be accomplished productively.

Hyperknowledge organization design imposes several requirements on theory development in information systems research. Walls, Widmeyer, and El Sawy (1992, p. 37) argue that the IS ìfield has now matured to the point where there is a need for theory development based on paradigms endogenous to the area itselfî and call for IS design theories (ISDT). An ISDT is ìa prescriptive theory based on theoretical underpinnings which says how a design process can be carried out in a way which is both effective and feasibleî (Walls, et al., 1992, p. 37).

But design theories are insufficient in the context of DIS. Information systems research must put equal emphasis on design and *use* of IS: IS design and use theories (ISDUT) are needed. The design/use dualism may be reinforced otherwise. Building an ISDUT for DIS is a challenging topic for future research.

References

Käkölä, T. "Increasing the Interpretive Flexibility of Information Systems through Embedded Application Systems," *Accounting, Management & Information Technologies* (5:1), 1995a, pp. 79-102.

Käkölä, T. "Designing and Deploying Coordination Technologies for Fostering Organizational Working and Learning: From Vision to Reality?", *Scandinavian Journal of Information Systems* (7:2), 1995b, pp. 45-74.

Käkölä, T. *Dual Information Systems in Hyperknowledge Organizations*, Ph.D. Dissertation, Turku Centre for Computer Science Dissertations No. 2, August 1996.

Other references available upon request from author.